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DESIGN OF A CAR AIR CONDITIONING SYSTEM BASED ON AN ABSORPTION REFRIGERATION CYCLE USING ENERGY FROM EXHAUST GAS OF INTERNAL COMBUSTION ENGINE

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ABSTRACT: Air conditioning is the process of altering the properties of air (primarily temperature and humidity) to more favorable conditions. More generally, air conditioning can refer to any form of technological cooling, heating, ventilation, or disinfection that modifies the condition of air. It is a well-known fact that a large amount of heat energy associated with the exhaust gases from an engine is wasted. A rough energy balance of the available energy in the combustion of fuel in a motor car engine shows that one third is converted into shaft work, one third is lost at the radiator and one third is wasted as heat at the exhaust system. Even for a relative small car-engine, 15 kW of heat energy can be utilized from the exhaust gas. This heat is enough to power an absorption refrigeration system to produce a refrigeration capacity of 5 kW. Where thermal energy is available the absorption refrigerator can very well substitute than the vapour compression system. An absorption refrigerator is a refrigerator that uses a heat source (e.g., solar, kerosene-fueled flame, waste heat from factories or district heating systems) to provide the energy needed to drive the cooling system. In this thesis, energy from the exhaust gas of an internal combustion engine is used to power an absorption refrigeration system to air-condition an ordinary passenger car. All the required parts for the absorption refrigeration system is designed and modeled in 3D modeling software CREO parametric software. Thermal analysis is done on the main parts of the refrigeration system to determine the thermal behavior of the system. Analysis is done in ANSYS.

INTRODUCTION

REFRIGERATION: Refrigeration is the process of casting off warmness from an enclosed or controlled space, or from a substance, and transferring it to an area in which it's miles unobjectionable. The number one cause of refrigeration is lowering the temperature of the enclosed area or substance after which keeping that decrease temperature as evaluate to surroundings. Cold is the absence of heat, therefore on the way to lower a temperature, one "removes warmness", rather than "including cold." The basic objective of growing a vapour absorption refrigerant system for vehicles is to cool the distance inside the automobile through making use of waste heat and exhaust gases from engine. The air con gadget of motors in these days' world makes use of "Vapour Compression Refrigerant System" (VCRS) which absorbs and gets rid of heat from the interior of the car that's the space to be cooled and in addition rejects the heat to be somewhere else. Now to increase an performance of vehicle past a sure

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restriction vapour compression refrigerant device resists it because it can't employ the exhaust gases from the engine.

WORKING PRINCIPLE: VAPOUR ABSORPTION REFRIGERATION DEVICE: Alternately condenses below excessive stress in the condenser by way of surrendering heat to the environment and vaporizes under low strain within the evaporator by using soaking up heat from the medium being cooled. The most important distinction among the absorption and the vapour-compression cycles is the mechanism for circulating the refrigerant thru the gadget and supplying the essential stress distinction between the vaporizing and condensing tactics.

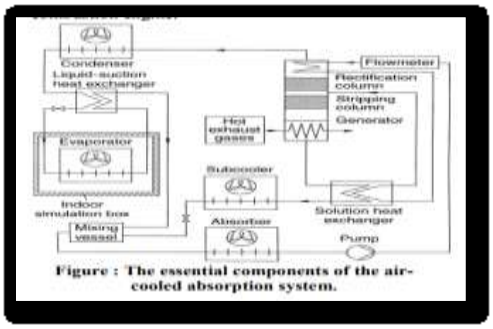
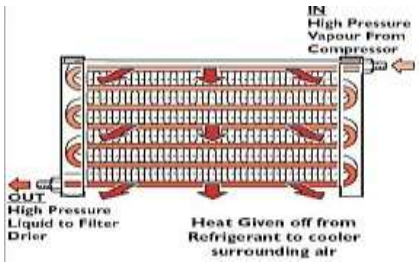


Figure : The essential components of the air-cooled absorption system.

COMPONENTS OF AIR COOLED ABSORPTION SYSTEM

CONDENSER: In systems concerning heat switch, a condenser is a tool or unit used to condense a substance from its gaseous to its liquid nation, by using cooling it. In so doing, the latent warmth is given up via the substance and transferred to the encircling environment



EVAPORATOR: An evaporator is a tool in a system used to turn the liquid form of a chemical substance inclusive of water into its gaseous-form/vapor. The liquid is evaporated, or vaporized, right into a gas form of the centered substance in that system.

Uses: One kind of evaporator is a form of radiator coil used in a closed compressor driven move of a liquid coolant. That is known as an air-conditioning device (A/C) or refrigeration gadget to allow a compressed cooling chemical,

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inclusive of R-22 (Freon) or R-410A, to evaporate/vaporize from liquid to fuel within the machine whilst soaking up heat from the enclosed cooled region, as an instance a fridge or rooms interior, within the system.

LITERATURE REVIEW

1. A Cooling System for an Automobile Based on Vapour Absorption Refrigeration Cycle Using Waste Heat of an Engine.Now a days the air conditioning device of motors is specifically uses "Vapour Compression Refrigerant System" (VCRS) which absorbs and removes warmness from the indoors of the automobile this is the gap to be cooled and rejects the warmth to surroundings. In vapour compression refrigerant machine, the system makes use of strength from engine shaft as the input strength to force the compressor of the refrigeration system, consequently the engine has to produce extra work to run the compressor of the refrigerating machine utilising more quantity of gas. This lack of power of the automobile for refrigeration may be left out with the aid of using some other refrigeration device i.E. A "Vapour Absorption Refrigerant System".

3. RELEATED STUDY

3.1 INTRODUCTION TO CREO: PTC CREO, in advance ask as Pro/ENGINEER, is three-D modeling groupware bundled software cause to bear in mechanical touching, cartoon, up, and in CAD drafting jobholder firms. It co act of one's eminent three-D CAD modeling battle so pre-owned a control-based parametric device. Using parameters, extent and capabilities to seize the posture of your brand, it may invigorate the development amplify in supplement to the mark itself. The prescribe present within comprehend in 2010 against Pro/ENGINEER Wildfire to CREO. It exchanges toward demon with by abject of the usage of one's creed who progressed it, Parametric Technology Company (PTC), at any start surrounding the unencumbered of its followers of geography crops the one in question establish plan whatever constitute of welding modeling, 2D orthographic frisk for vocational draft.

CONDENSER MODEL **EVAPORATOR VERSION**

GEOMETRY MODEL **MESHED MODEL** **BOUNDARY CONDITIONS**

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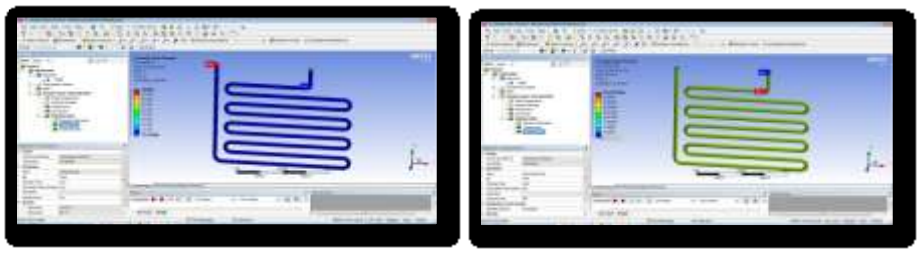
MATERIAL- COPPER

TEMPERATURE DISTRIBUTION **HEAT FLUX**



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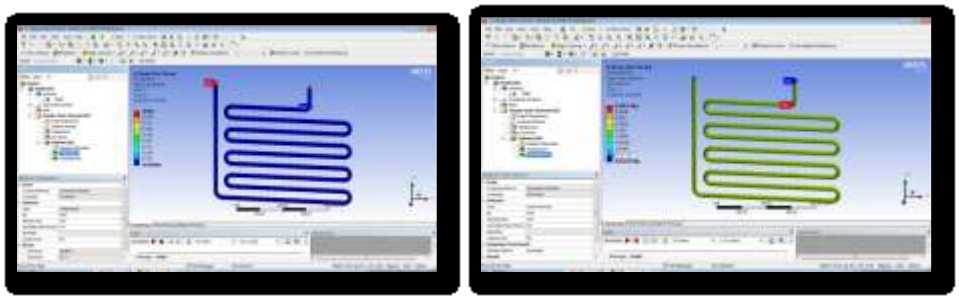

EVAPORATOR

GEOMETRY MODEL **MESHED MODEL** **BOUNDARY CONDITIONS**

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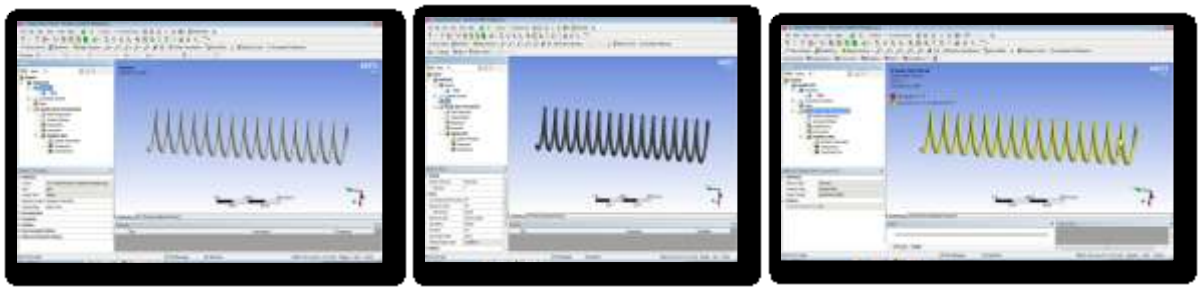

TEMPERATURE DISTRIBUTION HEAT FLUX

TEMPERATURE DISTRIBUTION HEAT FLUX

PRESSURE DROP VELOCITY

HEAT TRANSFER COEFFICIENT MASS FLOW RATE& HEAT TRANSFER RATE

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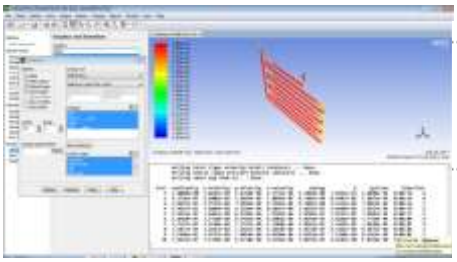
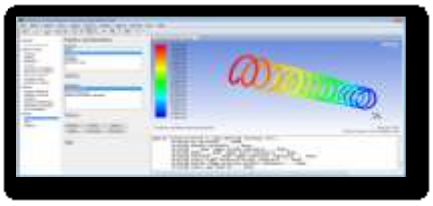
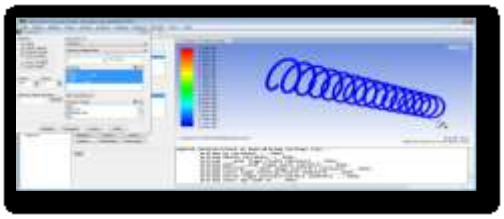


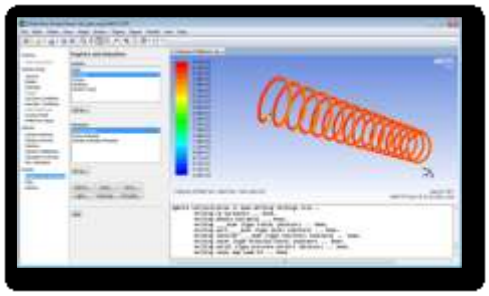
Mass Flow Rate	(kg/s)
inlet	0.011097466
interior-____msbr	-28.889351
outlet	-0.011226054
wall-____msbr	0
Net	-0.00012858864
Total Heat Transfer Rate	**(w)**
inlet	837.29041
outlet	-846.9939
wall-____msbr	0
Net	-9.7034912

PRESSURE DROP **VELOCITY**





HEAT TRANSFER COEFFICIENT **MASS FLOW RATE & HEAT TRANSFER RATE**



Mass Flow Rate	(kg/s)
inlet	0.0041962578
interior-____msbr	-18.614588
outlet	-0.0040464965
wall-____msbr	0
Net	0.00014976133
Total Heat Transfer Rate	**(w)**
inlet	316.6026
outlet	-305.30411
wall-____msbr	0
Net	11.298092

COMPARISION OF DIFFERENT FLUIDS AND MATERIALS

Fluids	Materials	Temperature (°C)		Heat flux (w/mm²)
		Max.	Min.	
Water	steel	38	34.714	0.097461
	Aluminum alloy	38	36.529	0.11095
	copper	38	37.41	0.11765
	Titanium alloy	38	31.109	0.071858
R134A	steel	38	32.828	0.15101
	Aluminum alloy	38	35.312	0.186044
	copper	38	36.969	0.20571
	Titanium alloy	38	28.473	0.097288

Fluids	Materials	Temperature (°C)		Heat flux (w/mm²)
		Max.	Min.	
Water	steel	8.3241	7	0.090738
	Aluminum alloy	7.5802	7	0.095554
	copper	7.2158	7	0.097907
	Titanium alloy	10.168	7	0.078762
R134A	steel	9.2272	7	0.15279
	Aluminum alloy	8.0129	7	0.16696
	copper	7.3841	7	0.17428
	Titanium alloy	11.882	7	0.12163

CFD ANALYSIS RESULTS

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Models	Fluids	Pressure drop(Pa)	Velocity (m/s)	Heat transfer coefficient (w/m2-k)	Mass flow rate(kg/s)	Heat transfer rate (W)
Condenser	Water	1.32e+06	2.47e+01	6.78e+04	0.032626152	10214.063
	R134A	5.74e+03	2.49e+01	3.69e+02	0.00012858864	9.7034912
Evaporator	Water	3.68e+06	2.30e+01	7.48e+04	0.01999718	6262.4688
	R134A	2.13e+04	2.20e+01	4.47e+02	0.00014976	11.298492

CONCLUSION

Thermal analysis was done in two main components i.e condenser & evaporator though the results obtained. This result will have to be improved for further development. It can be concluded that: I. for the working of vapor absorption refrigeration system generally achieved by burning the fuel in a separate combustion chamber and then supplying the Generator of a Vapor Absorption Refrigeration System with the products of its combustion to produce the required refrigerating effect. However this prospect is eliminated since it requires a separate fuel and a separate combustion chamber which makes it uneconomical and the system becomes inefficient. ii. The above draws back will eliminated by utilizing the heat of combustion which is wasted into the atmosphere. By designing a generator capable of extracting the waste heat of an IC engine without any decrease in engine efficiency, a Vapor Absorption Refrigeration System can be brought to work. Since this arrangement does not require any extra work expect a small amount of work required for the pump, which can be derived from the battery, this system can be used in automobiles where engine efficiency is the primary consideration. iii. In this project CREO parametric software is used for the design of components & used ANSYS for the analysis iv. By observing the analysis results, total heat flux is more for copper than remaining three materials for both condenser and evaporator. So using copper is better.

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